

25-2 Safety Glass : Effective date from 2016/1/1

Refer to: R43 01

25-2.1 Effective date and Scope:

25-2.1.1 Effective date from 2016/1/1, the category of M and N using new type of safety glass in the cabin (except for the dashboard) shall comply with this regulation.

25-2.1.2 The applicants applying for low volume safety approval or vehicle-by-vehicle low volume safety approval could exempt from regulation of "safety glass" except large passenger vehicle and child-only vehicle.

25-2.2 Definitions:

25-2.2.1 "Toughened-glass" means glazing consisting of a single layer of glass which has been subjected to special treatment to increase its mechanical strength and to condition its fragmentation after shattering.

25-2.2.2 "Laminated-glass" means glazing consisting of two or more layers of glass held together by one or more interlayer of plastics material; it may be:

25-2.2.2.1 "Ordinary laminated glass", when none of the layers of glass of which it is composed has been treated; or

25-2.2.2.2 "Treated laminated glass", when at least one of the layers of glass, of which it is composed, has been specially treated to increase its mechanical strength and to condition its fragmentation after shattering;

25-2.2.3 "Interlayer" means any material designed to be used to hold together the component layers of laminated-glass.

25-2.2.4 "Safety-glass faced with plastics material" means glazing as defined in paragraphs 25-2 2.1. or 25-2 2.2. with a layer of plastics material on its inner face.

25-2.2.5 "Glass-plastics" means glazing consisting of any glazing material that comprises one layer of glass and one or more layers of plastic in which a plastic surface of the product faces the inner side.

25-2.2.6 "Plastic glazing" is a glazing material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state and, at some stage in its manufacture or processing into finished articles, can be shaped by flow.

25-2.2.6.1 "Rigid plastic glazing" means a plastic glazing material which does not deflect vertically more than 50 mm in the flexibility test.

25-2.2.6.2 "Flexible plastic glazing" means a plastic glazing material which deflects vertically more than 50 mm in the flexibility test.

25-2.2.7 "Double window" means an assembly of two panes separately installed within the same opening of the vehicle.

25-2.2.8 "Double-glazed unit" means an assembly of two panes permanently assembled in manufacture and separated by a uniform gap.

25-2.2.8.1 "Symmetrical double-glazed unit" means a double-glazed unit where the two component glazing are identical (e.g., both

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toughened glass).

25-2.2.8.2 "Asymmetrical double-glazed unit" means a double-glazed unit where the two component glazing are not identical (e.g., one is toughened glass and the other is laminated glass).

25-2.2.9 "Bullet resistant glazing" or "Bullet-proof glazing", means glazing constructed so as to be resistant to firearms.

25-2.2.10 "Windscreen" means the glazing in front of the driver through which the driver views the road ahead.

25-2.2.11 "Developed area of windscreen" means the minimum rectangular area of glass from which a windscreen can be manufactured.

25-2.2.12 "Inclination angle of a windscreen" means the angle included between on the one hand a vertical line and on the other hand a straight line passing through the top and bottom edges of the windscreen, both lines being contained in a vertical plane containing the longitudinal axis of the vehicle;

25-2.2.12.1 Measurement of the inclination angle shall be performed on a vehicle standing on level ground, and in the case of a passenger-transport vehicle the vehicle shall be in running order, shall be fully charged with fuel coolant and lubricant, and shall be equipped with tools and the spare wheel or wheels (if they are provided as standard equipment by the vehicle manufacturer); allowance shall be made for the mass of the driver, and also, in the case of a passenger-transport vehicle, for that of one front-seat passenger, the mass of the driver and that of the passenger each being deemed to be 75 +/- 1 kg;

25-2.2.12.2 Vehicles equipped with hydropneumatic, hydraulic or pneumatic suspension or with a device for automatic adjustment of ground clearance according to load shall be tested in the normal running conditions specified by the manufacturer.

25-2.2.13 "Group of windscreens" means a group comprising windscreens of differing sizes and shapes subjected to an examination of their mechanical properties, their mode of fragmentation and their behaviour in environmental-aggression resistance tests.

25-2.2.13.1 "Flat windscreen" means a windscreen exhibiting no normal curvature resulting in a height of segment greater than 10 mm per linear meter;

25-2.2.13.2 "Curved windscreen" means a windscreen exhibiting a normal curvature resulting in a height of segment greater than 10 mm per linear meter.

25-2.2.14 "Pane" means any single piece of glazing other than a windscreen;

25-2.2.14.1 "Curved pane" means a pane with a height of segment "h" greater than 10 mm per linear meter;

25-2.2.14.2 "Flat pane" means a pane with a height of segment equal to or less than 10 mm per linear meter.

25-2.2.15 "Height of segment 'h' " means the maximum distance, measured at right angles approximately to the glazing, separating the inner surface of the glazing from a plane passing through the ends of the glazing.

25-2.2.16 "Nominal thickness": means the manufacturer's design thickness with a tolerance of +/- (n x 0.2 mm) where n equals the number of glass layers in the glazing.

25-2.2.17 "Curvature 'r' " means the approximate value of the smallest radius of arc of the windscreen as measured in the most curved

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area.

25-2.2.18 "HIC (Head Injury Criteria)" value means a value for the characteristics of skull-brain injury arising from the deceleration forces which result from a blunt perpendicular impact with the glazing.

25-2.2.19 "Safety glazing material requisite for driver visibility"

25-2.2.19.1 "Safety glazing material requisite for the driver's forward field of vision" means all the glazing situated in front of a plane passing through the driver's R point and perpendicular to the longitudinal median plane of the vehicle through which the driver can view the road when driving or manoeuvring the vehicle.

25-2.2.19.2 "Safety glazing material requisite for the driver's rearward field of vision" means all glazing situated behind a plane passing through the driver's R point and perpendicular to the longitudinal median plane of the vehicle through which the driver can view the road when driving or manoeuvring the vehicle.

25-2.2.20 "Opaque obscuration" means any area of the glazing preventing light transmission, including any screen-printed area, whether solid or dot-printed, but excluding any shade band.

25-2.2.21 "Shade band" means any area of the glazing with a reduced light transmittance, excluding any opaque obscuration.

25-2.2.22 "Transparent area of the windscreen" means the glazing area contained within the design glass outline, excluding any allowed opaque obscuration, but including any shade band.

25-2.2.23 "Design glass outline" means the design maximum unobstructed vehicle aperture designated to be glazed, before the glazing is installed or mounted, including all trims, but excluding obscuration bands.

25-2.2.24 "Optical distortion" means an optical defect in a windscreen that changes the appearance of an object viewed through the windscreen.

25-2.2.25 "Secondary image" means a spurious or ghost image, in addition to the bright primary image, usually seen at night when the object being viewed is very bright in relation to its surroundings, for example, the headlights of an approaching vehicle.

25-2.2.26 "Secondary image separation" means the angular distance between the position of the primary and secondary images.

25-2.2.27 "Regular light transmittance" means light transmittance measured perpendicularly to the glazing.

25-2.2.28 "Design seat-back angle" means the angle between the vertical line through the R point and the torso line defined by the vehicle manufacturer.

25-2.2.29 "Sample" means a specially prepared piece of glazing representative of a finished product or a piece cut from a finished product.

25-2.2.30 "Test piece" means a sample or a finished product of glazing.

25-2.3 Safety Glass and its installed stipulation

25-2.3.1 The safety glass of installed stipulation

25-2.3.1.1 Safety glazing shall be fitted in such a way that, despite the stresses to which the vehicles submitted

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under normal operating conditions, it remains in position and continues to afford visibility and safety to the occupants of the vehicle;

25-2.3.1.2 The category M and N of vehicles of stipulation

25-2.3.1.2.1 Windscreens

25-2.3.1.2.1.1 The regular light transmittance shall not be less than 70 per cent.

25-2.3.1.2.1.2 The windscreen must be correctly fitted with reference to the vehicle driver's 'R' point.

25-2.3.1.2.2 Safety glass except for windscreens.

25-2.3.1.2.2.1 The safety glazing through which the driver's forwards field of vision , must have a regular light transmittance of at least 70 per cent.

25-2.3.1.2.2.2 The safety glazing must have a light transmittance of at least 70 per cent, but where two exterior rear view mirrors are fitted, the glazing is allowed to have a light transmittance below 70 per cent.

25-2.3.2 The safety glass panes shall be subjected to the tests listed in the following table:

Tests	Scope	Windscreen	Glass panes other than windscreens				
		Laminated glass (L)	Toughened glass (T)	Laminated glass (L)	Rigid plastic glazings	Rigid plastic double glazed units	Flexible plastic glazings
Thickness test		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fragmentation test		---*2	<input type="checkbox"/>	---	---	---	---
227 g ball test		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2260 g ball test		<input type="checkbox"/>	---	---	---	---	---
Headform test		<input type="checkbox"/>	---		<input type="checkbox"/> *3	<input type="checkbox"/> *3	---
Test of resistance to abrasion		<input type="checkbox"/>	---	<input type="checkbox"/>	<input type="checkbox"/> *4	<input type="checkbox"/> *4	---
Test of resistance to high temperature		<input type="checkbox"/>	---	<input type="checkbox"/>	---	---	---
Resistance-to-radiation test		<input type="checkbox"/>	---	<input type="checkbox"/>	---	---	---

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Resistance-to-humidity test	<input type="checkbox"/>	---	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---
Light-transmission test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Optical-distortion test	<input type="checkbox"/>	---	---	---	---	---
Secondary-image-separation test	<input type="checkbox"/>	---	---	---	---	---
Test of flexible	---	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note 1: laminated-glass pane (a glass pane consisting of one layers of glass held together by multiple interlayers of plastics material;)

2 : a glass pane consisting of a single layer of glass which has been subjected to special treatment to increase its mechanical strength and to condition its fragmentation after shattering;

3 : For panes which do not have contact possibilities as well as a 150 mm diameter circle cannot be scribed, both of them will be exempt from the requirement.

4 : For sun roofs, no test is required.

25-2.4 Safety Glass shall according to suitable types and range of principle as below :

25-2.4.1 Trade name

25-2.4.2 Category of glass (toughened-glass, laminated-glass, rigid plastic glazings, rigid plastic double glazed units, flexible plastic glazings)

25-2.4.3 Nominal thickness

25-2.5 Thickness test:

25-2.5.1 for the Laminated glass (including laminated-glass pane) , the nominal thickness can bear a tolerance of $\pm 0.2 (n)$ mm, where n is the number of layers of glass.

25-2.5.2 For the toughened-glass pane, the tolerance of can reach ± 0.2 mm.

25-2.5.3 For Rigid plastic glazings and rigid plastic double glazed units, The thickness tolerance limit of the nominal thickness. for extruded plastic products is $\pm 10\%$ of the nominal thickness. For plastic products produced by other techniques (e.g. cast acrylic sheet), the acceptable thickness tolerance is given by the equation (thickness tolerance limits (mm) = $\pm (0.4 + 0.1 e)$ where e is the sheet thickness in mm.

25-2.5.4 Flexible plastic glazings , a manufacturing tolerance of the nominal thickness being allowed: is $\pm (0.1 \text{ mm} + 0.1e)$ where e is the sheet thickness in mm.

25-2.6 Fragmentation test:

25-2.6.1 Number of samples: By using the complete products, four samples per set in the case of flat glass panes, or four samples per set

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in the case of curved glass panes that radius of curvature "r" is equal or more than 200 mm, or eight samples per set in the case of curved glass panes that radius of curvature "r" is less than 200 mm. Treated laminated-glass windscreens, One test piece measuring (1,100 x 500 mm) ± 2 mm or one sample for each point of impact shall be subjected to testing.

25-2.6.1.1 For flat glass panes the points of impact represented respectively in figure 7(a) and (b). For curved glass panes the points of impact represented in figure 7-1,

25-2.6.2 A hammer of about 75 g or some other appliance giving equivalent results shall be used. The radius of curvature of the point shall be 0.2 ± 0.05 mm. The fragmentation test should be held compliant with the following regulations:

25-2.6.2.1 Treated laminated-glass windscreens :

25-2.6.2.1.1 For each point of impact the fragmentation test shall be considered to have given a satisfactory result if the total surface area of fragments having a surface area of more than 2 cm² comprised in a rectangle as (at least 20 cm high and 50 cm long) , represents not less than 15 per cent of the surface of that rectangle.

25-2.6.2.1.2 In the case of a sample:

25-2.6.2.1.2.1 For vehicles of category M1, the centre of the rectangle shall be situated within a circle having a radius of 10 cm centred on the projection of the middle of segment V1 V2.

25-2.6.2.1.2.2 For vehicles of categories M and N other than M1, the centre of the rectangle shall be situated within a circle having a radius of 10 cm centred on the projection of point O.

25-2.6.2.1.2.3 The height of the above rectangle may be reduced to 15 cm for windscreens which are less than 44 cm high or whose angle of installation is less than 15 degrees from the vertical; the percentage of visibility shall at least be equal to 10 per cent of the area of Material Index of difficulty the corresponding rectangle.

25-2.6.2.1.3 In the case of a test piece, the centre of the rectangle shall be situated on the greater axis of the test piece at 450 mm from one of its edges.

25-2.6.2.1.4 When the test having been repeated on a new set of four test pieces for each point of impact for which it had originally given an unsatisfactory result, then four new tests performed at the same impact points shall be conducted and shall all give a satisfactory result.

25-2.6.2.2 For the toughened-glass pane not for use for windshield

25-2.6.2.2.1 The number of fragments in any 5 cm x 5 cm square is not less than 40, A fragment extending across a side of a square shall count as half a fragment.

25-2.6.2.2.2 Fragmentation shall not be checked in a strip 20 mm wide round the edge of the samples, this strip representing the frame of the glass; nor within a radius of 75 mm from the point of impact. When a fragment extends beyond the excluded area only the part of the fragment falling outside of the area shall be assessed. Fragments of an area exceeding 3 cm²

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shall not be allowed.

25-2.6.2.2.3 A few fragments of elongated shape shall be allowed, provided that: their ends are not converge to a point, if they extend to the edge of the glass pane they do not form an angle of more than 45 degrees with it, and if, except in the case provided for in paragraph 25-2.6.2.4 below, their length does not exceed 100 mm.

25-2.6.2.2.4 Three of the four tests carried out at each of the points of impact above-mentioned have given a satisfactory result.

25-2.6.2.2.5 If the above-mentioned deviations are found, they shall be noted in the test report and permanent recording(s) of the fragmentation pattern of the relevant parts of the glass pane shall be attached to the report.

25-2.7 227 g ball test:

25-2.7.1 Test piece: The test piece shall be a flat square of side $300 \pm 10/0$ mm

25-2.7.2 Condition the test piece at 23 ± 2 °C for at least four hours (Rigid plastic glazings and flexible plastic glazings must be stored for 48 hours · rigid plastic double glazed units must be stored for 24 hours) immediately preceding the test. The test is processed using a hardened-steel ball with a mass of 227 ± 2 g and a diameter of approximately 38mm, and dropping the ball freely from a height specified in the following table or giving the ball a velocity equivalent to that obtained by the free fall. The point of impact shall be within 25 mm of the geometric centre of the test piece for a drop height less than or equal to 6 m, and within 50 mm of the centre of the test piece for a drop height greater than 6 m. The ball shall strike that face of the test piece, which represents the outside face of the safety-glazing pane when mounted on the vehicle.

25-2.7.2.1 The test conditions of laminated-glass pane are tabulated as below:

Scope	Amount of Tested Specimens/ Permitted first tested of un-satisfactory result	Height of fall(m) Nominal thickness e (mm)	Temperature (°C)		
			40±2	-20±2	20±5
Windscreen	10 / 2	$e \leq 4.5$ $4.5 < e \leq 5.5$ $5.5 < e \leq 6.5$ $6.5 < e$	9 999	8.5 8.58.58. 5	-
Glass panes other than windscreen	8 / 2	$e \leq 5.5$ $5.5 < e \leq 6.5$ $6.5 < e$	-	-	9m+25-0mm 9m+25-0mm 9m+25-0mm

25-2.7.2.2 A satisfactory result for laminated-glass pane:

25-2.7.2.2.1 Windscreen: The ball does not pass through the test piece and the test piece does not break into several pieces. If

the interlayer is not torn, the weight of fragments detached from the side of the glass opposite to the point of impact must not exceed the appropriate values specified in the table below:

25-2.7.2.2.2 Glass panes other than windscreen:

25-2.7.2.2.2.1 The ball does not pass through the test piece.

25-2.7.2.2.2.2 The test piece does not break into several pieces.

25-2.7.2.2.2.3 At the point immediately opposite the point of impact, small fragments of glass may leave the specimen, but the small area thus affected shall expose less than 645 mm² of reinforcing or strengthening material, the surface of which shall always be well covered with tiny particles of tightly adhering glass. Total separation of glass from the reinforcing or strengthening material shall not exceed 1,935 mm² on either side. Spalling of the outer glass surface opposite the point of impact and adjacent to the area of impact is not to be considered a failure.

Scope	Nominal thickness e (mm)	Maximum permitted mass of the fragments, (g)
windscreen	$e \leq 4.5$	12
	$4.5 < e \leq 5.5$	15
	$5.5 < e \leq 6.5$	20
	$6.5 < e$	25
Glass panes other than windscreen		15

A set of test pieces submitted for approval shall be considered satisfactory from the point of view of the 227 g ball test if at least eight of the ten tests carried out windscreen at each temperature, or at least six of the ten tests carried out glass panes other than windscreen at each temperature, have given a satisfactory result.

25-2.7.2.3 Six test pieces shall be subjected to testing for each thickness category, and the test condition is tabulated as follows:

Type	Nominal thickness e (mm)	Height of drop (m)
Toughened-glass pane	$e \leq 3.5$	2.0m +5-0 mm
	$e > 3.5$	2.0m +5-0 mm

25-2.7.2.4 The test shall be deemed to have given a satisfactory result if at least five of the test pieces do not break..

25-2.7.2.5 Test conditions of rigid plastic glazings and rigid plastic double glazed units are listed in the table below:

Scope	Amount of Tested Specimens/ Permitted first tested of un-satisfactory result	Height of fall(m) Nominal thickness e (mm)	Temperature (°C)	
			-18±2	23±2

rigid plastic glazings and rigid plastic double glazed units	10 / ≥ 2	< 3	2	2
		4	3	3
		5	4	4
		>6	5	5

For intermediate values of thickness in the interval between 3 mm and 6 mm, the height of drop shall be interpolated.

25-2.7.2.6 The rigid plastic glazings and rigid plastic double glazed units ball test shall be considered to have given a satisfactory result if the following conditions are met: the ball does not penetrate the test piece, the test piece does not break into separate pieces.

25-2.7.2.7 Test conditions of flexible plastic glazings in the table below:

Scope	Amount of Tested Specimens/ Permitted first tested of un-satisfactory result	Height of fall(m) Nominal thickness e (mm)	Temperature (°C)	
			-18 \pm 2	23 \pm 2
flexible plastic glazings	10 / ≥ 2	All of thickness	2	2

25-2.7.2.8 The flexible plastic glazings ball test shall be considered to have given a satisfactory result if the following conditions are met: the ball does not penetrate the test piece.

25-2.8 2260 g ball test:

25-2.8.1 Twelve square test pieces of 300mm \pm 10/-0 side shall be subjected to testing.

25-2.8.2 Condition the test piece at 20 \pm 5°C for at least four hours immediately preceding the test.

25-2.8.3 The test is processed using a hardened-steel ball mass of 2260 \pm 20 g and a diameter of approximately 82mm, and dropping the ball freely from a height of 4m or giving the ball a velocity equivalent to that obtained by the free ball. The point of impact shall be within 25mm of the geometric centre of the test piece. The ball shall strike that face of the test piece which represents the inward face of the safety-glass pane when the latter is mounted on the vehicle.

25-2.8.4 The test shall be deemed to have given a satisfactory result if the ball does not pass through the glazing within five seconds after the moment of impact.

25-2.8.5 A set of test pieces submitted for approval shall be considered satisfactory from the point of view of the 2,260 g ball test if at least eleven of the twelve tests have given a satisfactory result.

25-2.9 Headform test:

25-2.9.1 In the case of windscreen, four samples of complete windscreen or six flat test pieces shall be tested. In the case of glass panes other than windscreen, six flat test pieces measuring (1,100 mm x 500 mm) \pm 5/-2 (5/2) shall be subjected testing.

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- 25-2.9.2 The flat test piece shall be kept at a constant temperature of $20 \pm 5^{\circ}\text{C}$ for at least four hours immediately preceding the test.
- 25-2.9.3 The total mass of the headform shall be 10 (± 0.2) kg, and dropping the ball freely from a height of 1.5m (4m for the flat test piece of windscreen) or giving the ball a velocity equivalent to that obtained by the free ball. The weight shall strike the test piece within 40mm of the geometric centre on that face which represents the inward face of the safety-glass pane when the latter is mounted on the vehicle.
- 25-2.9.4 In the case of complete sample, this test shall be deemed to have given a satisfactory result if the following conditions are fulfilled:
- 25-2.9.4.1 The sample breaks displaying numerous circular cracks centred approximately on the point of impact, the cracks nearest to the point of impact being not more than 80 mm from it;
- 25-2.9.4.2 The layers of glass shall remain adhering to the plastics-material interlayer. One or more partial separation from the interlayer with a distance of less than 4 mm in breadth, on either side of the crack, is permitted outside a circle of 60 mm in diameter centred on the point of impact.
- 25-2.9.4.3 On the impact side: The interlayer must not be laid bare over an area of more than 20 cm².
- 25-2.9.4.4 A tear in the interlayer up to a length of 35 mm is allowed.
- 25-2.9.5 In the case of test pieces, this test shall be deemed to have given a satisfactory result if the following conditions are met:
- 25-2.9.5.1 The test piece yields and breaks, displaying numerous circular cracks centred approximately on the point of impact,
- 25-2.9.5.2 Tears in the interlayer are allowed, but the manikin's head must not pass through,
- 25-2.9.5.3 No large fragments of glass shall become detached from the interlayer.
- 25-2.9.6 A set of test pieces submitted for approval shall be considered satisfactory from the point of view of the headform test if all the tests give a satisfactory result.

25-2.10 Test of resistance to abrasion:

25-2.10.1 Test pieces: three pieces of squares of side 100 mm.

25-2.10.2 The methods of haze calculation

Immediately place the test piece against the entrance port of the integrating sphere. The angle between the normal (perpendicular) to the surface of the test piece and the axis of the light beam shall not exceed 8 degrees .

Take four readings as indicated in the following table:

Reading	With test piece	With light-trap	With reflectance standard	Quantity represented
T ₁	No	No	Yes	Incident light
T ₂	Yes	No	Yes	Total light transmitted by test-piece
T ₃	No	Yes	No	Light scattered by instrument
T ₄	Yes	Yes	No	Light scattered by instrument and

Repeat readings for T1, T2, T3, and T4 with other specified positions of the test piece to determine uniformity.
 Calculate the total transmittance $T_t = T_2/T_1$.
 Calculate the total transmittance T_d as follows:

$$T_d = \frac{T_4 - T_3(T_2/T_1)}{T_1 - T_3}$$

Calculate the percentage haze, or light, or both, scattered, as follows:
 Haze, or light, or both, scattered,

$$= \frac{T_d}{T_i} \times 100\%$$

the

Measure the initial haze of the test piece at a minimum of four equally-spaced points in the unabraded area in accordance with formula above. Average the results for each test piece. In lieu of the four measurements, an average value may be obtained by rotating the piece uniformly at 3 rev/sec or more.

25-2.10.3 Condition the test pieces for a minimum time of 48 hours at 20 +/- 5 degrees C and 60 +/- 20 per cent relative humidity.

25-2.10.4 The abrasion test shall be carried out on that surface of the test piece which represents the outside face of the laminated-glass pane when the latter is mounted on the vehicle. Abrading instrument consists of a horizontal turntable, which revolves counter-clockwise at 65 to 75 rev/min, and two weighted parallel arms each carrying a special abrasive wheel freely rotating; each wheel rests on the test specimen under the pressure exerted by a mass of 500 g, the test being continued for 1000 cycles (Rigid plastic glazings and rigid plastic double glazed units can be declared as M by applicant then it can be reduced to 500 times) . and measure the haze once again. if coated on the inner face with a layer of plastics material, the plastics coating shall be subjected to a test for 100 cycles and measure the haze once again.

25-2.10.5 The wheels shall have a hardness of 72 ± 5 IRHD (International Rubber Hardness).

25-2.10.6 Outer surface, the light scatter as a result of abrasion of the test piece does not exceed 2%. In the case of glazing of class M, the

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abrasion test shall be considered to have given a satisfactory result if the total light scatter after abrasion does not exceed 10 per cent after 500 cycles on the outer surface of the test sample and 4 per cent after 100 cycles on the inner surface of the test sample.

25-2.10.7 All test pieces shall conform to the requirements defined above.

25-2.11 Test of resistance to high temperature:

25-2.11.1 Test pieces: three samples or three square test pieces of at least 300 x 300 mm.

25-2.11.2 Heat test pieces to 100°C. Maintain this temperature for a period of two hours, then allow the test pieces to cool to room temperature.

25-2.11.3 The test for resistance to high temperature shall be considered to give a positive result if bubbles or other defects are not formed more than 15 mm from an uncut edge or 25 mm from a cut edge of the test piece or sample or more than 10 mm away of any cracks which may occur during the test.

25-2.11.4 A set of test pieces or samples submitted for approval shall be considered satisfactory from the point of view of the test for resistance to high temperature if all the tests have given a satisfactory result.

25-2.12 Resistance-to-radiation test:

25-2.12.1 Test pieces: three test pieces, with size of 76 mm x 300 mm.

25-2.12.2 Maintain the temperature of the test pieces at $45 \pm 5^{\circ}\text{C}$ throughout the test. That face of each test piece which would constitute a glazed exterior part of the vehicle shall face the lamp. place the test pieces in the test apparatus 230 mm from and parallel lengthwise to the lamp axis (750 ± 50 W quartz mercury lamp or equivalent one) and the exposure time to UV shall be 100 hours.

25-2.12.3 The total light transmittance does not fall below 95 % of the original value before irradiation and in any event does not fall below 70 % in the case of windscreens and other glazing located in a position requisite for driving visibility.

25-2.12.4 A set of test pieces or samples submitted for approval shall be considered satisfactory from the point of view of the resistance to radiation test if all the tests have given a satisfactory result.

25-2.13 Resistance-to-humidity test:

25-2.13.1 Test pieces: Three square test pieces of at least 300 x 300 mm (In the case of rigid plastic glazings and rigid plastic double glazed units, the number of samples shall be ten).

25-2.13.2 Keep test pieces in a vertical position for two weeks in a closed container in which the temperature is maintained at $50 \pm 2^{\circ}\text{C}$ and the relative humidity at $95 \pm 4\%$.

25-2.13.3 Test pieces shall be comply with following regulations:

25-2.13.3.1 Laminated glass:

25-2.13.3.1.1 Safety glazing shall be deemed to be satisfactory from the point of view of resistance to humidity if no significant change is observed more than 10 mm from the uncut edges and more than 15 mm from the cut edges after ordinary and treated laminated glass panes have been maintained for two hours in the ambient atmosphere, and plastics-faced and glass-plastics panes have been maintained for 48 hours in the ambient atmosphere.

25-2.13.3.1.2 A set of test pieces or samples submitted for approval shall be considered satisfactory from the point of view of the test for resistance to humidity if all the tests have given a satisfactory result.

25-2.13.3.2 Rigid plastic glazings and rigid plastic double glazed units

25-2.13.3.2.1 No visible decompositions like bubbles or milkiness occur on any sample,

25-2.13.3.2.2 and if the light transmittance measured does not fall to less than 95% of the pre-test value and additionally to no less than 70% for any window required for driver visibility.

25-2.14 Light-transmission test

25-2.14.1 Test piece: One test piece for the complete product. For the laminated-glass windscreens of M1 vehicles the test shall be carried out in test area B (see figure 2, 3), For the laminated -glass windscreens of N1 vehicles, the manufacturer may request that the same test may be carried out either in test area B, or in the zone I (see Fig 5), for windscreens of other categories of vehicles, the test shall be carried out in the zone I; For the glass panes other than windscreen, the test piece of laminated-glass pane and the test piece of toughened -glass pane are both cut from the complete products.

25-2.14.2 The sensitivity of the measuring system shall be adjusted in such a way that the instrument indicating the response of the receiver indicates 100 divisions when the safety-glass pane is not inserted in the light path. Insert the safety-glass pane between the diaphragm and the receiver and adjust its orientation in such a way that the angle of incidence of the light beam is equal to 0 +/- 5 degrees. The regular transmittance should be measured on the safety-glass pane and for every point measured the number of divisions, n, shown on the indicating instrument, shall be read.

25-2.14.3 The regular transmittance zeta is equal to $n/100$. Before 2010/01/01, the regular transmittance measured in the case of windscreens shall not be less than 75 % and, in the case of windows other than windscreens shall not be less than 70 %. From 2010/01/01, the regular transmittance measured of windscreens or other than windscreens shall not be less than 70 %..In the case of glass panes in places not essential for the driver's vision (e.g. sun roofs) the regular light transmittance of the glass pane may be less than 70 %. Glass panes with a regular light transmittance less than 70 % shall be appropriately marked.

25-2.15 Optical distortion test

25-2.15.1 Test pieces: four samples (complete product) shall be submitted for testing.

25-2.15.2 The windscreen shall be mounted at the same angle of inclination as on the vehicle, at a distance of 4 m from the light source,

and measure the angular deviation $\Delta\alpha$ measured between two points M and M' on the surface of the glass pane, on the display screen 6-8 m away from the light source, see figure 6.

25-2.15.3 The maximum value of optical distortion:

For vehicle symbol category N1, the manufacturer may request that the same test may be carried out either in test area A/ B, or in the zone I.

25-2.15.3.1 For vehicle symbol categories M1 and N1 in the extended test area A (an area extended to the median plane of the vehicle, as indicated in Fig 1, and in the corresponding part of the windscreen symmetrical to it about the longitudinal medium plane of the vehicle): 2' of arc.

25-2.15.3.2 For vehicle symbol categories M1 and N1 in the reduced test area B (see Fig 2 and 3): 6' of arc.

25-2.15.3.3 For vehicles of categories M and N except for M1, in zone I (see Fig 5): 2' of arc.

25-2.16 Secondary-image-separation test

25-2.16.1 Test pieces: four complete samples shall be submitted for testing.

25-2.16.2 The distance between the test piece and the light box is more than 7 m. Mount the test piece at the specified rake angle. Determine whether the secondary image of the spots shifts beyond the point of tangency with the inside edge of the circle..

25-2.16.3 The maximum values of the separation of the primary and secondary images:

For vehicle symbol category N1, the manufacturer may request that the same test may be carried out either in test area A/ B, or in the zone I.

25-2.16.3.1 For vehicle symbol category M1 and N1 in the extended test area A (an area extended to the median plane of the vehicle, as indicated in Fig 1, and in the corresponding part of the windscreen symmetrical to it about the longitudinal medium plane of the vehicle): 15' of arc.

25-2.16.3.2 For vehicle symbol category M1 and N1 in the reduced test area B (see Fig 2 and 3): 25' of arc.

25-2.16.3.3 For vehicles of categories M and N except for M1, in zone I (see Fig 5): 15' of arc.

25-2.17 Flexibility test and fold test

25-2.17.1 Test pieces: a rectangular flat sample 300 mm long and 25 mm wide and four pieces shall be tested.

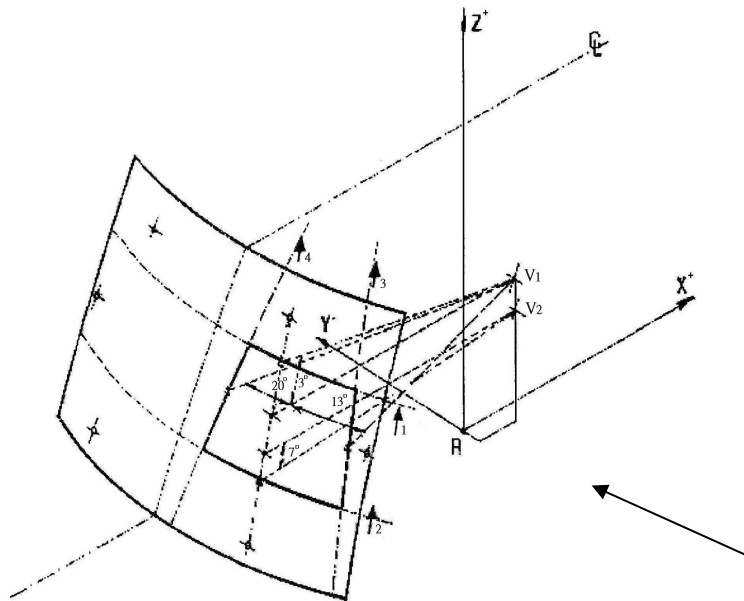
25-2.17.2 25 mm wide is cut out and horizontally clamped into a clamping device in such a way that 275 mm of the length of the sample freely extend over the holding device. (Temperature: 20 degrees C +/- 2 degrees C , relative Humidity: 60 % +/- 5 %)

25-2.17.3 Test pieces shall comply with following regulations:

25-2.17.3.1 Rigid plastic: Sixty seconds after removal of this support the vertical deviation of the free end must be less than 50 mm.

25-2.17.3.2 Flexible plastic: Sixty seconds after removal of this support the vertical deviation be more than 50 mm, and 10 seconds

after a 180 degrees - folding the material shall not show any fracture-like damages at the point of buckling.



In relation to the 'R' point,
test area shall be determined from the V points (see Fig 4), bounded by the intersection of the following four planes:
Plane 1: a plane inclined upwards from the X axis at 3 degrees, passing through V1, and parallel to the Y axis.
Plane 2: a plane inclined downwards from the X axis at 1 degrees, passing through V2, and parallel to the Y axis.
Plane 3: a vertical plane passing through V1 and V2 and inclined at 13 degrees to the left of the X axis.
Plane 4: a vertical plane passing through V1 and V2 and inclined at 20 degrees to the right of the X axis.

Fig 1. Test area A of windscreen

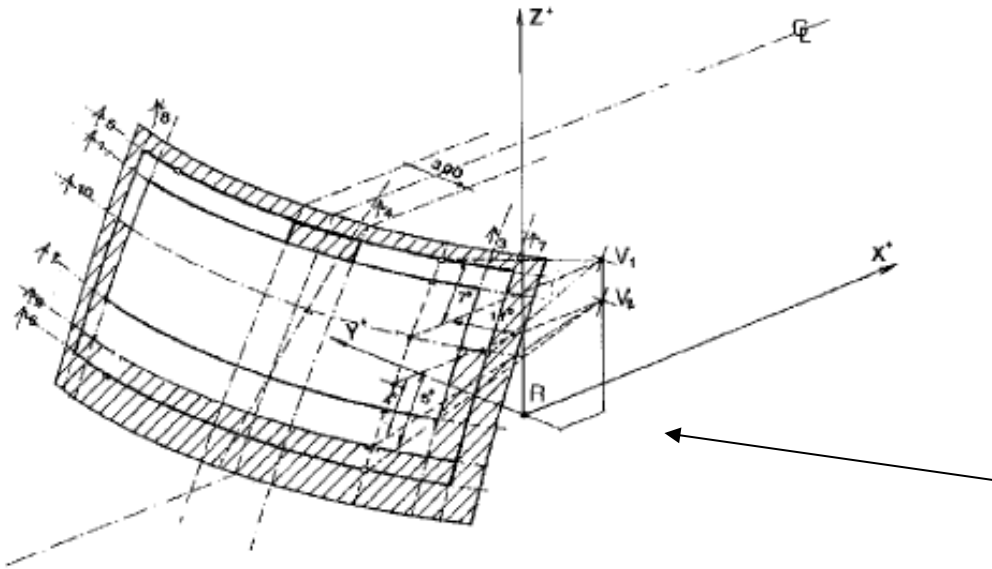


Fig 2. Test area B of windscreen (example 1)

Test Area B

In relation to the 'R' point,

test area shall be determined from the V points, bounded by the intersection of the following four planes:

Plane 5: a plane inclined upwards from the X axis at 7 degrees, passing through V1, and parallel to the Y axis.

Plane 6: a plane inclined downwards from the X axis at 5 degrees, passing through V2, and parallel to the Y axis.

Plane 7: a vertical plane passing through V1 and V2 and inclined at 17 degrees to the left of the X axis.

Plane 8: a plane symmetrical with respect to plane 7 in relation to the longitudinal median plane of the vehicle.

The reduced test plane B :

It 's the test area B with the exclusion of the following areas:

1. The test area A extended to the median plane of the vehicle, and in the corresponding part of the windscreen symmetrical to it about the longitudinal medium plane of the vehicle.
2. At the discretion of the vehicle manufacturer, one of the two following paragraphs may apply:
 - (1) any opaque obscuration bounded downwards by plane 1 and laterally by plane 4 and its symmetrical in relation to

- the longitudinal median plane of the vehicle (plane 4');
(2) any opaque obscuration bounded downwards by plane 1 provided it is inscribed in an area 300 mm wide centred on the longitudinal median plane of the vehicle and provided the opaque obscuration below the plane 5 trace is inscribed in an area limited laterally by the traces of planes passing by the limits of a 150 mm wide segment and parallel respectively to the traces of planes 4 and 4'
3. Any opaque obscuration bounded by the intersection of the outer surface of the windscreen:
- (1) with a plane inclined downwards from the X axis at 4 degrees, passing through V2, and parallel to the Y axis (plane 9);
 - (2) with plane 6.
 - (3) with planes 7 and 8 or the edge of the outer surface of the windscreen if the intersection of plane 6 with plane 7 (plane 6 with plane 8) doesn't cross the outer surface of the windscreen.
4. Any opaque obscuration bounded by the intersection of the outer surface of the windscreen:
- (1) with a horizontal plane passing through V1 (plane 10);
 - (2) with plane 3;
 - (3) with plane 7 or the edge of the outer surface of the windscreen if the intersection of plane 6 with plane 7 (plane 6 with plane 8) doesn't cross the outer surface of the windscreen;
 - (4) with plane 9.
5. An area within 25 mm from the edge of the outer surface of the windscreen or from any opaque obscuration. This area shall not impinge on the area in item 1. (i.e. the extended test area A).

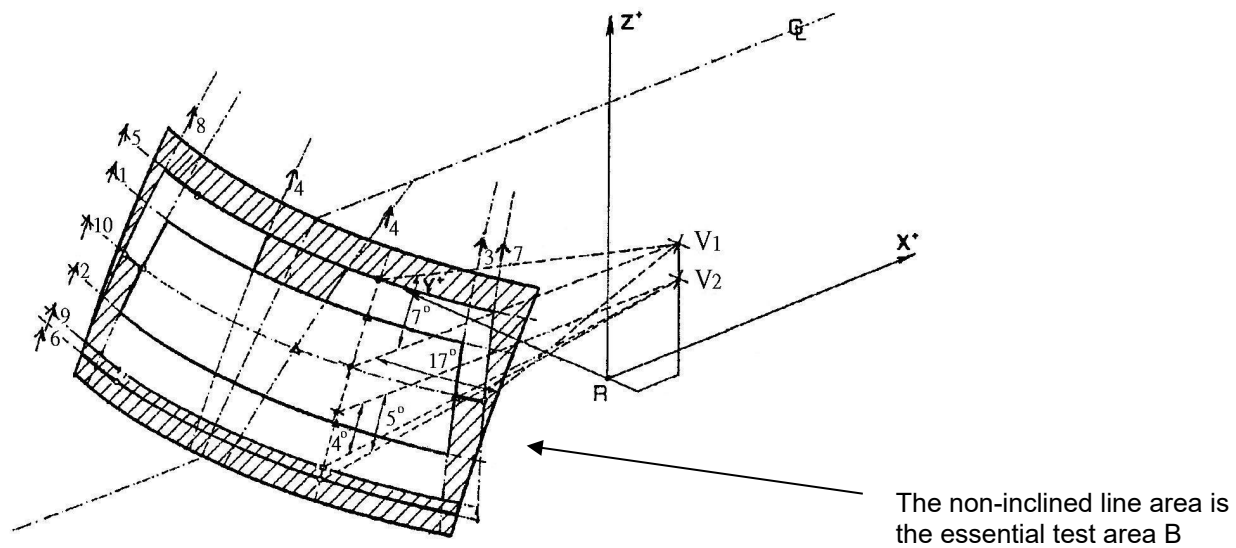
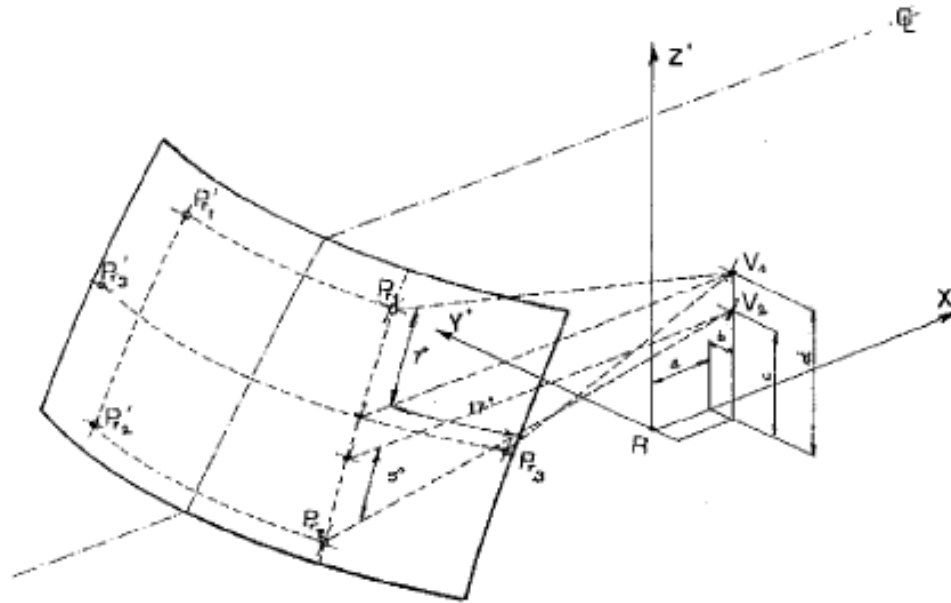


Fig 3. Test area B of windscreen (example 2)

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1. Following gives the basic co-ordinates a, b, c and d for a design seat-back angle of 25 degrees:

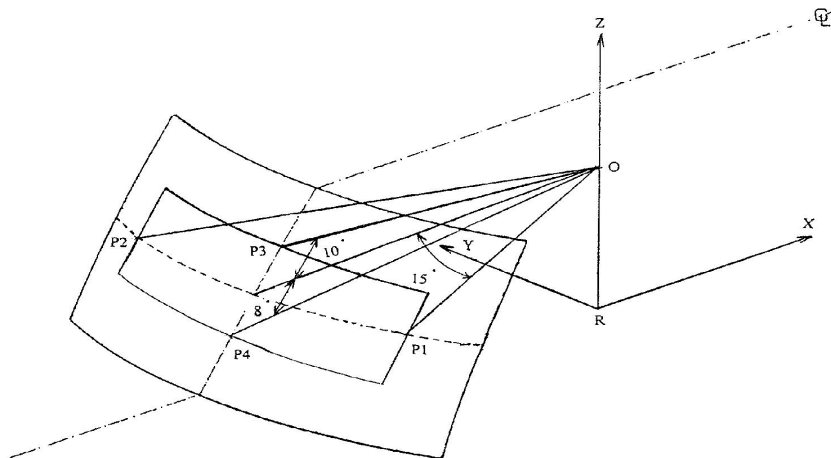
V-point a: V1 = 68mm, V2= 68mm.

V-point b: V1= -5mm, V2= -5mm.

V-point c (d): V1 =665mm, V2=589mm.

2. Table 1 shows the further corrections to be made to the X and Z co-ordinates of each 'V' point when the design seat-back angle is not 25 degrees.

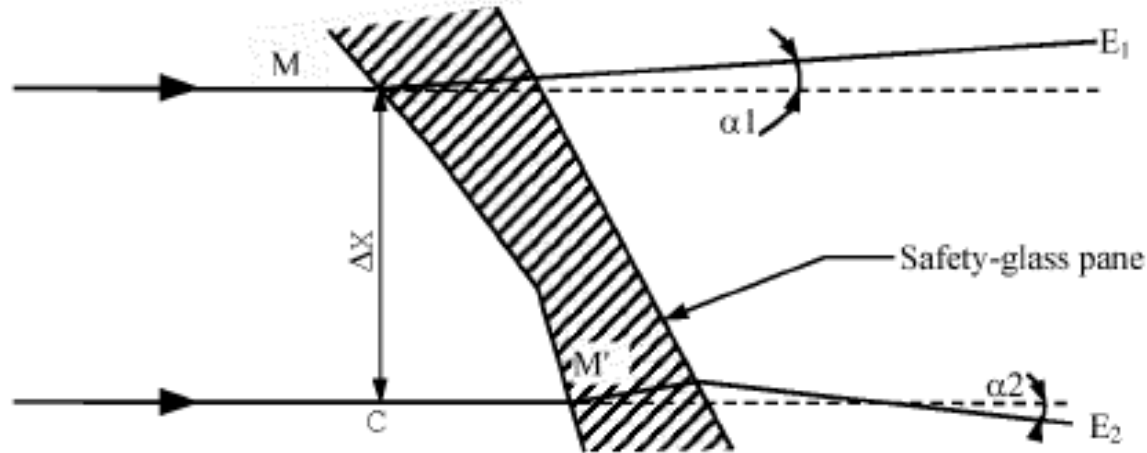
Fig 4. Determination of V points



Note:

1. Zone I is the windscreen zone determined by the intersection of the windscreen with the four planes defined below:
 - P_1 : a vertical plane passing through O and forming an angle of 15 degrees to the left of the median longitudinal plane of the vehicle;
 - P_2 : a vertical plane symmetrical to P_1 about the median longitudinal plane of the vehicle. If this is not possible (in the absence of a symmetrical median longitudinal plane, for instance) P_2 shall be the plane symmetrical to P_1 about the longitudinal plane of the vehicle passing through point O.
 - P_3 : a plane passing through the straight line OQ and forming an angle of 10 degrees above the horizontal plane;
 - P_4 : a plane passing through the straight line OQ and forming an angle of 8 degrees below the horizontal plane.
2. The "eye-point" O which is the point located 625 mm above the point R of the driver's seat in the vertical plane parallel to the longitudinal median plane of the vehicle for which the windscreen is intended, passing through the axis of the steering wheel.
3. The straight line OQ which is the horizontal straight line passing through the eye point O and perpendicular to the median longitudinal plane of the vehicle.

Fig 5. Test area I



Note: $\Delta\alpha = \alpha_1 - \alpha_2$ is the optical distortion in the direction M-M'.
 $\Delta x = MC$ is the distance between two straight lines parallel to the direction of vision and passing through the points M and M'.

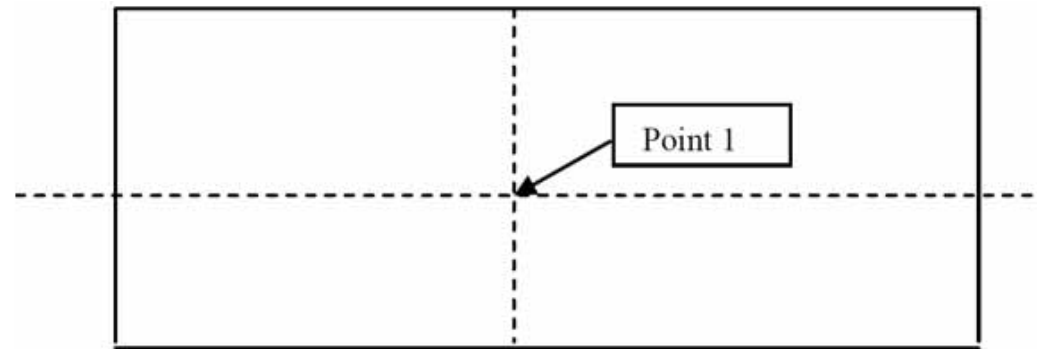
Fig 6. Diagrammatic representation of optical distortion

Table 1. Correction for design seat-back angles other than 25 degrees

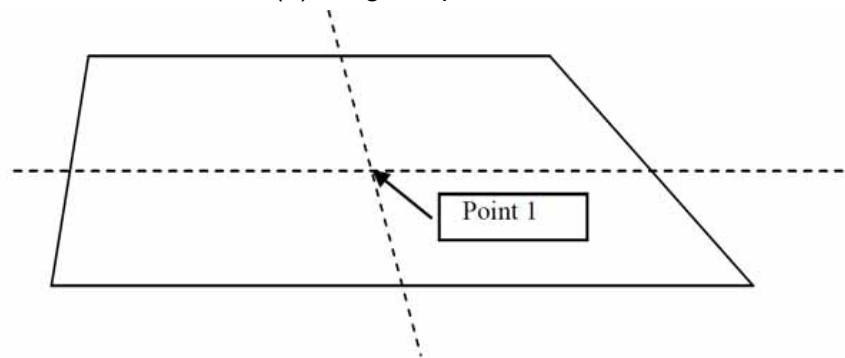
Seatback angle(in degrees)	Horizontal coordinates X	Vertical coordinates Z	Seatback angle(°)	Horizontal coordinates X	Vertical coordinates Z
5	-186 mm	28 mm	23	- 17mm	5 mm
6	-176 mm	27 mm	24	- 9 mm	2 mm
7	-167 mm	27 mm	25	0 mm	0 mm
8	-157 mm	26 mm	26	9 mm	- 3 mm
9	-147 mm	26 mm	27	17 mm	- 5 mm
10	-137 mm	25 mm	28	26 mm	- 8 mm
11	-128 mm	24 mm	29	34 mm	-11 mm
12	-118 mm	23 mm	30	43 mm	-14 mm
13	-109 mm	22 mm	31	51 mm	-17 mm
14	- 99 mm	21 mm	32	59 mm	-21 mm

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15	- 90 mm	20 mm	33	67 mm	-24 mm
16	- 81 mm	18 mm	34	76 mm	-28 mm
17	- 71 mm	17 mm	35	84 mm	-31 mm
18	- 62 mm	15 mm	36	92 mm	-35 mm
19	- 53 mm	13 mm	37	100 mm	-39 mm
20	- 44 mm	11 mm	38	107 mm	-43 mm
21	- 35 mm	9 mm	39	115 mm	-47 mm
22	- 26 mm	7 mm	40	123 mm	-52 mm



(a) flat glass pan

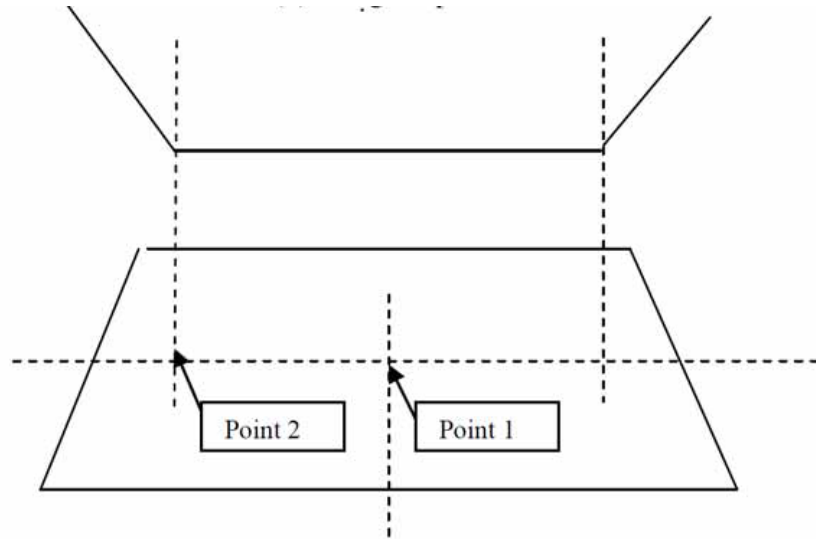


(b) flat glass pan

Point 1: In the geometric centre of the glass.

Fig 7. Prescribed points of impact for uniformly toughened flat glass panes

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Point 1: In the geometric centre of the glass.

Point 2: For curved glass panes having a minimum radius of curvature "r" of less than 200 mm. The point shall be selected on the largest median in that part of the pane where the radius of curvature is smallest.

Fig 7-1. Prescribed points of impact for uniformly toughened curved glass panes